FORMULAS FOR BLOCK BRAKES.

Contributed by A. L. Campbell.

F = force in pounds at end of brake handle,

P = tangential force in pounds at rim of brake wheel,

μ = coefficient of friction between the brake block and brake wheel.

(1) Block brake (Fig. 1)

For rotation in either direction:

$$F = P\frac{b}{a+b} \times \frac{1}{\mu} = \frac{Pb}{a+b}\left(\frac{1}{\mu}\right)$$

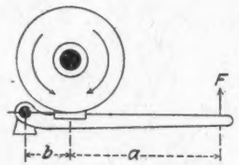

Fig. 1.

(2) Block brake (Fig. 2)

For clockwise rotation:

$$F = \frac{\frac{Pb}{\mu} - Pc}{a+b} = \frac{Pb}{a+b}\left(\frac{1}{\mu} - \frac{c}{b}\right)$$

For counter clockwise rotation:

$$F = \frac{\frac{Pb}{\mu} + Pc}{a+b} = \frac{Pb}{a+b}\left(\frac{1}{\mu} + \frac{c}{b}\right)$$

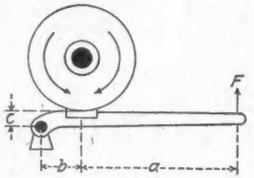

Fig. 2.

(3) Block brake (Fig. 3)

For clockwise rotation:

$$F = \frac{\frac{Pb}{\mu} + Pc}{a+b} = \frac{Pb}{a+b}\left(\frac{1}{\mu} + \frac{c}{b}\right)$$

For counter clockwise rotation:

$$F = \frac{\frac{Pb}{\mu} - Pc}{a+b} = \frac{Pb}{a+b}\left(\frac{1}{\mu} - \frac{c}{b}\right)$$

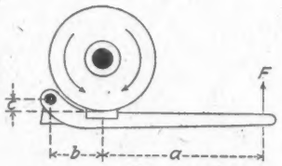

Fig. 3.

The brake wheel and friction block of the block brake are often grooved as shown by Fig. 4. In this case substitute for μ in the above equations the value $\frac{\mu}{\sin\alpha + \mu\cos\alpha}$ where α is one half the angle included by the faces of the grooves.

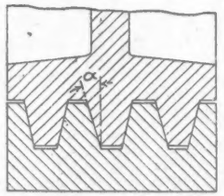

Fig. 4.

FORMULAS FOR SIMPLE AND DIFFERENTIAL BAND BRAKES.

Contributed by A. L. Campbell.

F = force in pounds at end of brake handle,

P = tangential force in pounds at rim of brake wheel,

e = base of natural logarithms = 2.71828,

μ = coefficient of friction between the brake band and the brake wheel,

θ = angle of contact of the brake band with the brake wheel, expressed in radians (one radian = $\frac{180^\circ}{\pi}$ = 57.296 degrees),

$$T_1 = P\frac{1}{e^{\mu\theta}-1}, \qquad T_2 = P\frac{e^{\mu\theta}}{e^{\mu\theta}-1}$$

(1) Simple band brake (Fig. 1)

For clockwise rotation:

$$F = \frac{bT_2}{a} = \frac{Pb}{a}\left(\frac{e^{\mu\theta}}{e^{\mu\theta}-1}\right)$$

For counter clockwise rotation:

$$F = \frac{bT_1}{a} = \frac{Pb}{a}\left(\frac{1}{e^{\mu\theta}-1}\right)$$

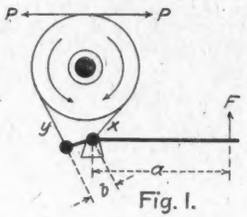

Fig. 1.

(2) Simple band brake (Fig. 2)

For clockwise rotation:

$$F = \frac{bT_1}{a} = \frac{Pb}{a}\left(\frac{1}{e^{\mu\theta}-1}\right)$$

For counter clockwise rotation:

$$F = \frac{bT_2}{a} = \frac{Pb}{a}\left(\frac{e^{\mu\theta}}{e^{\mu\theta}-1}\right)$$

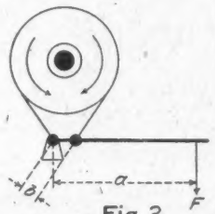

Fig. 2.

(3) Differential band brake (Fig. 3)

For clockwise rotation:

$$F = \frac{b_2T_2 - b_1T_1}{a} = \frac{P}{a}\left(\frac{b_2e^{\mu\theta} - b_1}{e^{\mu\theta}-1}\right)$$

For counter clockwise rotation:

$$F = \frac{b_2T_1 - b_1T_2}{a} = \frac{P}{a}\left(\frac{b_2 - b_1e^{\mu\theta}}{e^{\mu\theta}-1}\right)$$

In this case, if b_2 is equal to, or less than, $b_1e^{\mu\theta}$, the force F will be 0 or negative and the band brake works automatically.

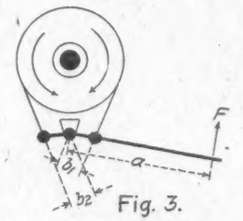

Fig. 3.

(4) Differential band brake (Fig. 4)

For clockwise rotation:

$$F = \frac{b_2T_2 + b_1T_1}{a} = \frac{P}{a}\left(\frac{b_2e^{\mu\theta} + b_1}{e^{\mu\theta}-1}\right)$$

For counter clockwise rotation:

$$F = \frac{b_1T_2 + b_2T_1}{a} = \frac{P}{a}\left(\frac{b_1e^{\mu\theta} + b_2}{e^{\mu\theta}-1}\right)$$

If $b_2 = b_1$, both of the above formulas reduce to $F = \frac{Pb_1}{a}\left(\frac{e^{\mu\theta}+1}{e^{\mu\theta}-1}\right)$. In this case the same force F is required for rotation in either direction.

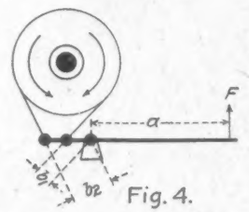

Fig. 4.

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Supplement to MACHINERY

Tables for the Articles in this number entitled "Band and Block Brakes" and

I.—TABLE FOR BLOCK OR MULTIPLE INDEXING.

Contributed by Racquet.

Teeth to be cut	Number indexed at once	First Driver	First Follower	Second Driver	Second Follower	Turns of Locking Disc
25	4	100	50	72	30	4
26	3	100	50	90	52	4
27	2	100	50	60	54	4
28	3	100	50	90	56	4
29	3	100	50	90	58	4
30	1	100	50	60	60	2
31	3	100	50	90	62	4
32	3	100	50	90	64	4
33	4	100	50	80	44	4
34	3	100	50	90	68	4
35	4	100	50	96	56	4
36	5	100	48	80	40	4
37	5	100	30	90	74	4
38	5	100	30	90	76	4
39	5	100	30	90	78	4
40	3	100	50	90	80	4
41	5	100	30	90	82	4
42	5	100	30	90	84	4
43	5	100	30	90	86	4

Teeth to be cut	Number indexed at once	First Driver	First Follower	Second Driver	Second Follower	Turns of Locking Disc
62	5	100	30	90	62	2
63	5	100	30	80	56	2
64	5	100	30	90	64	2
65	4	100	50	96	52	2
66	5	100	44	80	40	2
67	5	100	30	90	67	2
68	5	100	30	90	68	2
69	5	100	46	80	40	2
70	3	100	50	90	70	2
72	5	100	30	90	72	2
74	5	100	30	90	74	2
75	7	100	30	84	50	2
76	5	100	30	90	76	2
77	4	100	70	96	44	2
78	5	100	30	90	78	2
80	3	100	50	90	80	2
81	7	100	30	84	52	2
82	5	100	30	90	82	2
84	5	100	30	90	84	2

II.—TABLE FOR BLOCK OR MULTIPLE INDEXING.

Contributed by Racquet.

Teeth to be cut	Number indexed at once	First Driver	First Follower	Second Driver	Second Follower	Turns of Locking Disc
104	5	100	60	90	52	2
105	4	100	70	96	60	2
108	7	100	30	70	60	2
110	7	100	50	84	44	2
111	5	100	74	80	40	2
112	5	100	60	90	56	2
114	7	100	30	84	76	2
115	8	100	50	96	46	2
116	5	100	60	90	58	2
117	8	100	30	96	78	2
119	3	100	70	72	68	2
120	7	100	50	70	40	2
121	4	60	66	96	44	2
123	7	100	30	84	82	2
124	5	100	60	90	62	2
125	7	100	50	84	50	2
126	5	100	50	50	42	2
128	5	100	60	90	64	2
129	7	100	30	84	86	2

Teeth to be cut	Number indexed at once	First Driver	First Follower	Second Driver	Second Follower	Turns of Locking Disc
152	5	100	60	90	76	2
153	5	100	68	80	60	2
154	5	100	56	72	66	2
155	6	100	50	72	62	2
156	5	100	60	90	78	2
160	7	100	50	84	64	2
161	5	100	70	60	46	2
162	7	100	60	84	52	2
164	5	100	60	90	82	2
165	7	100	50	84	66	2
168	5	100	60	90	84	2
169	6	96	52	90	78	2
170	7	100	50	84	68	2
171	5	70	42	80	76	2
172	5	100	60	90	86	2
174	7	100	60	84	58	2
175	8	100	50	96	70	2
176	5	100	60	90	88	2
180	7	100	60	70	50	2

126	5	100	50	50	42	2	175	8	100	50	96	70	2
128	5	100	60	90	64	2	176	5	100	60	90	88	2
129	7	100	30	84	86	2	180	7	100	60	70	50	2
130	7	100	50	84	52	2	182	9	90	58	96	52	2
132	5	100	88	80	40	2	184	5	100	60	90	92	2
133	4	100	70	96	76	2	185	6	100	50	72	74	2
134	5	100	60	90	67	2	186	7	100	60	84	62	2
135	7	100	50	84	54	2	187	5	100	44	48	68	2
136	5	100	60	90	68	2	188	5	100	60	90	94	2
138	5	100	92	80	40	2	189	5	100	60	80	84	2
140	3	50	50	90	70	2	190	7	100	50	84	76	2
141	5	100	94	80	40	2	192	5	100	60	90	96	2
143	6	90	66	96	52	2	195	7	100	50	84	78	2
144	5	100	60	90	72	2	196	5	100	60	90	98	2
145	6	100	50	72	58	2	198	7	100	50	70	66	2
147	5	100	98	80	40	2	200	7	60	60	84	40	2
148	5	100	60	90	74	2							
150	7	100	60	84	50	2							

41	5	100	30	90	82	4	81	7	100	30	84	52	2
42	5	100	30	90	84	4	82	5	100	30	90	82	2
43	5	100	30	90	86	4	84	5	100	30	90	84	2
44	5	100	30	90	88	4	85	4	100	50	96	68	2
45	7	100	60	70	30	4	86	5	100	30	90	86	2
46	5	100	30	90	92	4	87	7	100	30	84	58	2
47	5	100	30	90	94	4	88	5	100	30	90	88	2
48	5	100	30	90	96	4	90	7	100	30	70	50	2
49	5	100	30	90	98	4	91	3	100	70	72	52	2
50	7	100	50	84	40	4	92	5	100	30	90	92	2
51	4	100	30	96	68	2	93	7	100	30	84	62	2
52	5	100	30	90	52	2	94	5	100	30	90	94	2
54	5	100	30	90	54	2	95	4	100	50	96	76	2
55	4	100	50	96	44	2	96	5	100	30	90	96	2
56	5	100	30	90	56	2	98	5	100	30	90	98	2
57	4	100	30	96	76	2	99	10	100	30	80	44	2
58	5	100	30	90	58	2	100	7	100	50	84	40	2
60	7	100	30	84	40	2	102	5	100	30	60	68	2